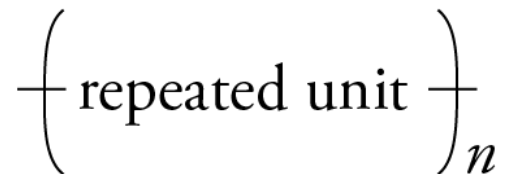


Polymers

- A **polymer** is a large molecule with simple repeating units.
- The simple repeating units are called **monomers**.
- Polymer formulas are described with the formula for the monomer in parentheses with an n as a subscript to indicate some large integer number. The n varies even for a sample of the same polymer.



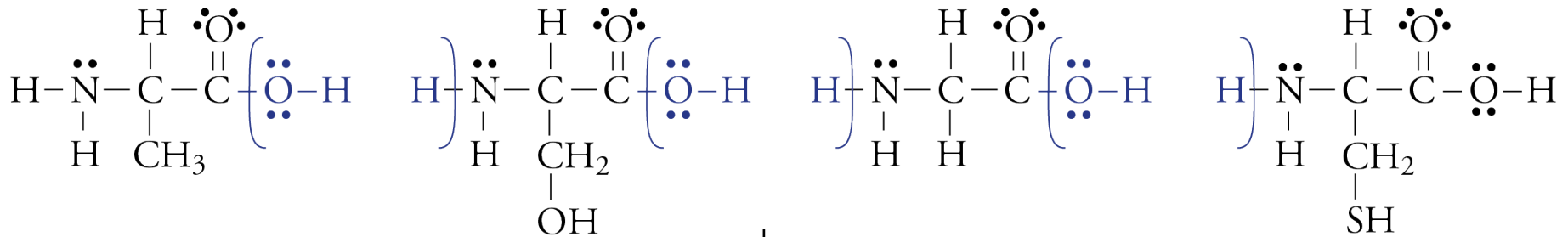
General polymer formula

Natural and Synthetic Polymers

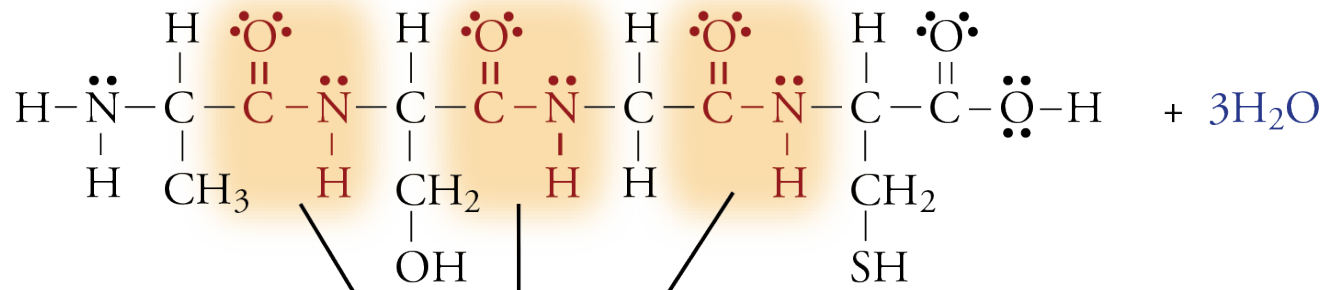


- Natural polymers include
 - Starches with glucose monomers
 - Proteins with amino acid monomers
- Synthetic polymers are produced by chemists. Examples include, nylon, polyester, polyethylene, poly(vinyl chloride), polypropylene, and polystyrene.

Formation of Ala-Ser-Gly-Cys

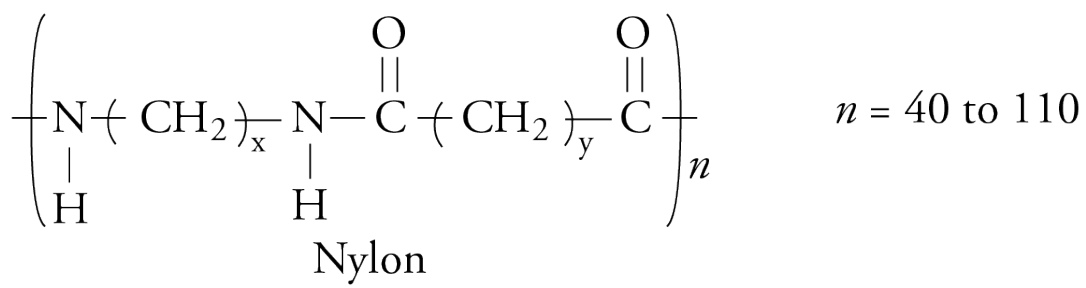
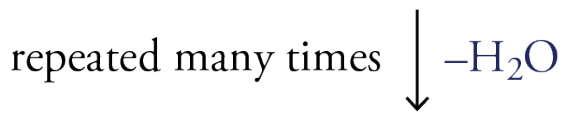
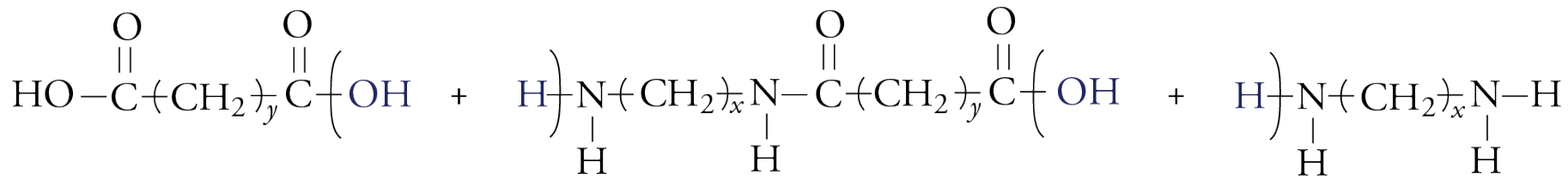
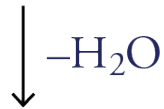
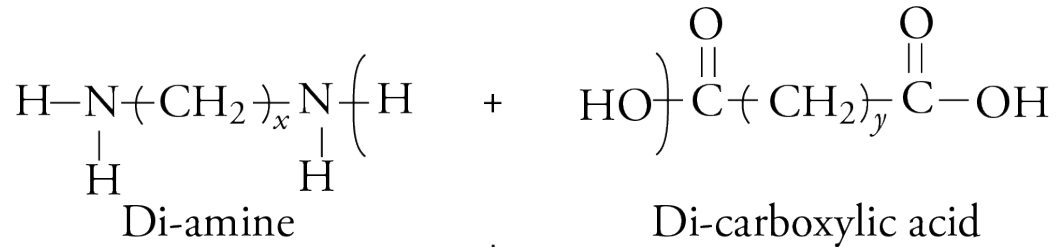


↓ Condensation reaction releases water

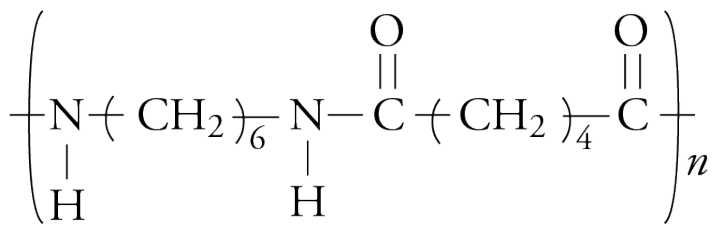


peptide bonds (amide functional groups)

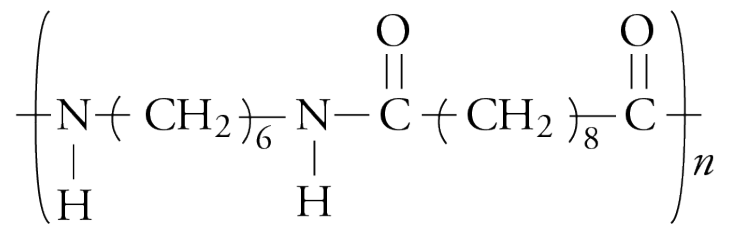
Nylon Formation



Examples



Nylon 66



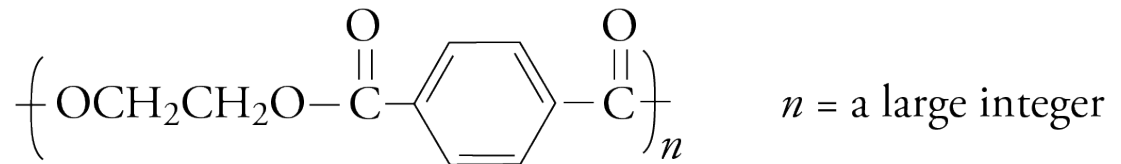
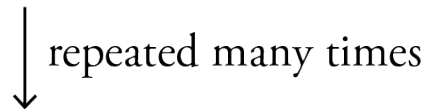
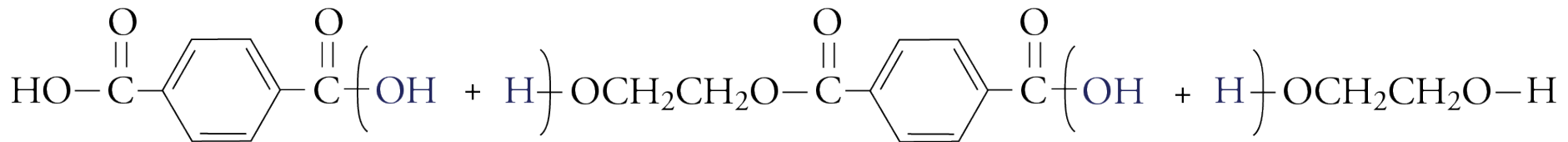
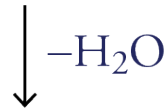
Nylon 610

Condensation Polymers



- **Condensation polymers** are polymers that are formed by condensation reactions in which two molecules are joined and a small molecule, such as water, is released.

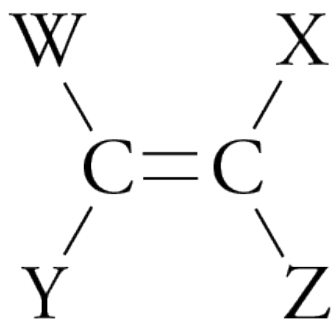
Polyester Formation

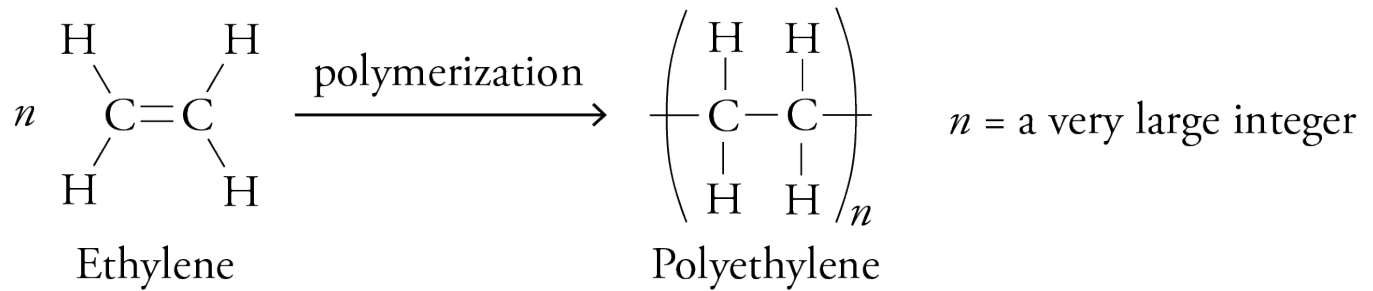


Poly(ethylene terephthalate)

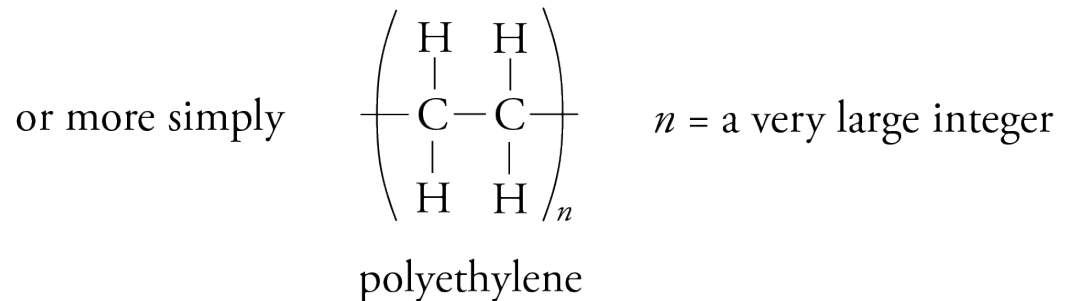
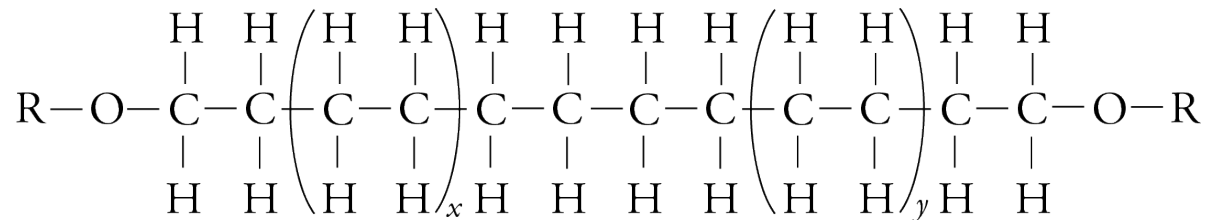
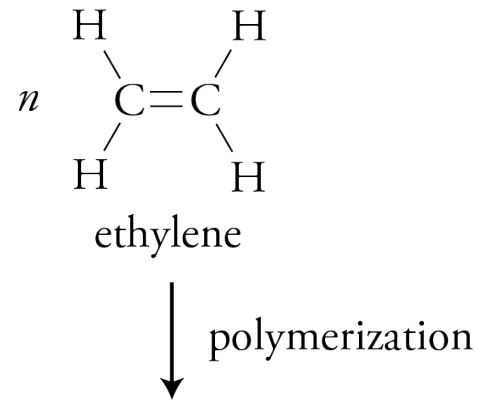
Addition Polymers

- Addition polymers are made from molecules that have the following general formula.

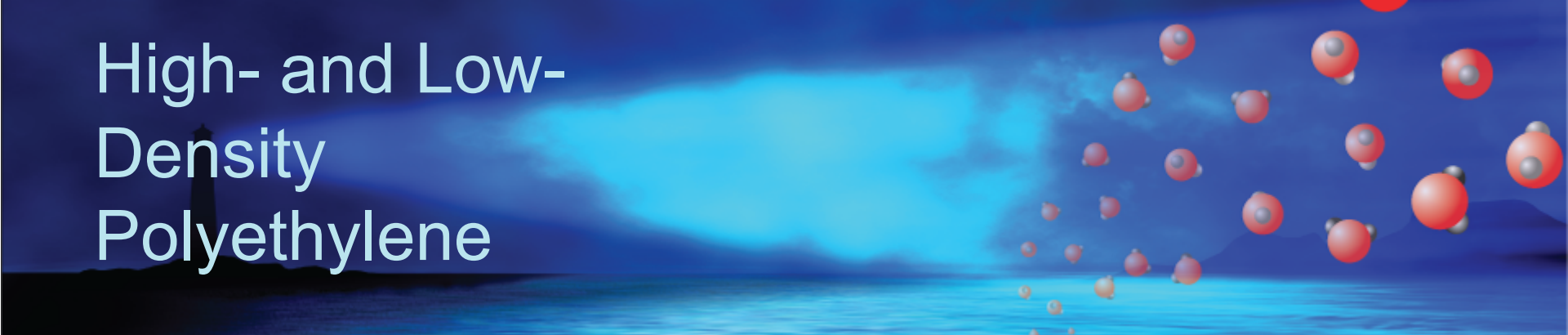




Polyethylene Formation

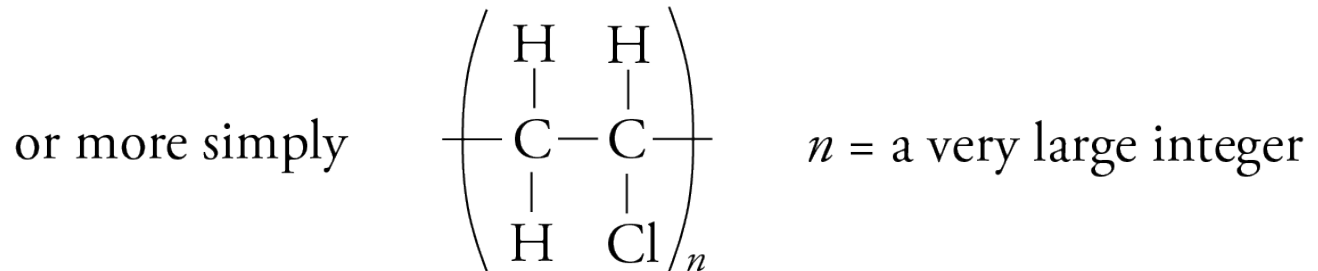
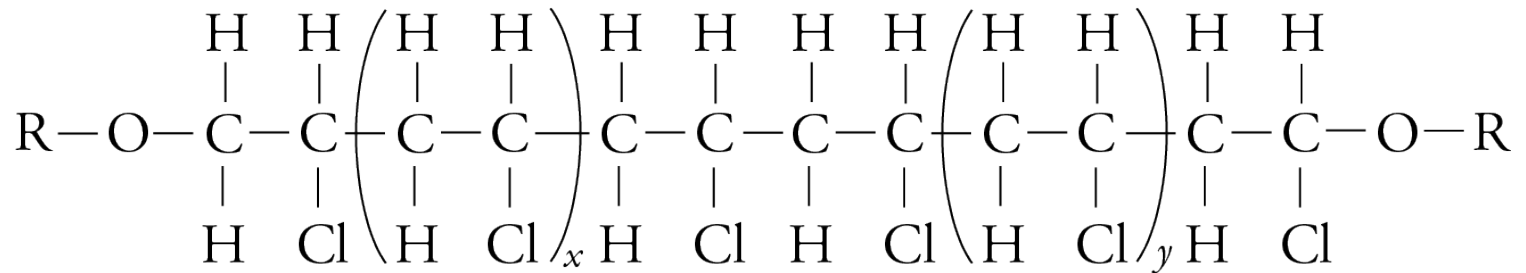
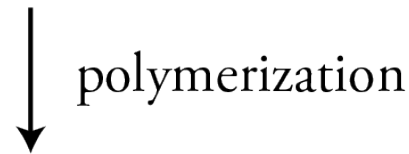
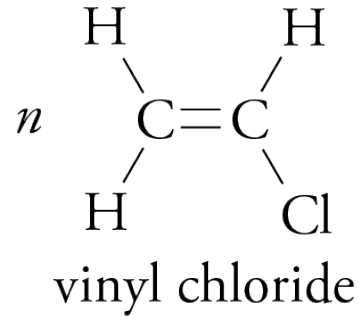


High- and Low-Density Polyethylene



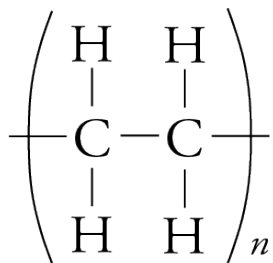
- If polyethylene is made under conditions that lead to mostly unbranched chains, the chains are able to pack together tightly forming high-density polyethylene, which is described by the acronym HDPE or sometimes PE-HD.
- If the polyethylene is made in a way that encourages branches, the molecules do not pack together as tightly, forming low-density polyethylene, which is described by the acronym LDPE or sometimes PE-LD.

Poly(vinyl chloride) or PVC

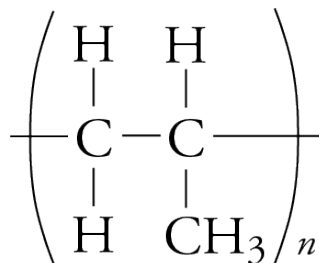


poly(vinyl chloride) or PVC

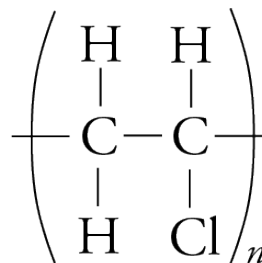
Addition Polymers



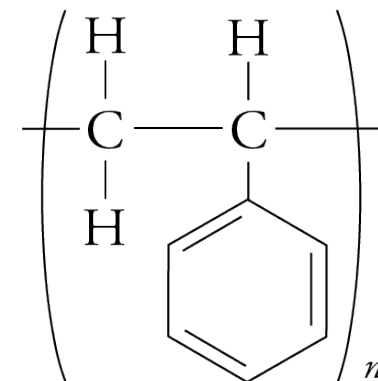
Polyethylene
(HDPE or
LDPE)



Polypropylene
(PP)



Poly(vinyl chloride)
(PVC)



Polystyrene
(PS)

Recycling Codes



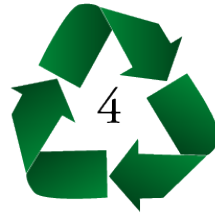
PET
(or PETE)



HDPE
(or PE-HD)



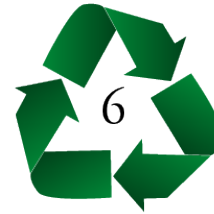
PVC
(or V)



LDPE
(or PE-LD)



PP



PS



OTHER